91602
new 82-10

ontario hydro
research division

COMPLIMENTARY COPY
Please Credit Ontario Hydro Research if Reproduced in Whole or in Part

To: Dr. C.F. Lee
Manager
Geotechnical and Hydraulic Engineering Department
Design and Development Division

Attn: Mr. R. Jarrett

CLAIREVILLE TS TO VAUGHAN MTS
U/G CABLE THERMAL RESISTIVITY SURVEY

In situ and laboratory measurements of the soil thermal resistivity were made for the proposed underground cable portion of the above transmission line. The soil types encountered were moist clayey silt and silty clay. The ground water table was not encountered within the depth of sampling and in situ measurements (1.5 m). In situ thermal resistivity values ranged from 60 to 90°C cm/W. Based on the statistical analysis of 50 year weather data, the worst case thermal resistivity of 120°C cm/W is recommended to be used for the native soil in the ampacity calculations and the design of cable thermal backfill.

INTRODUCTION

A soil thermal resistivity survey was conducted for the U/G cable section of the proposed transmission line from Claireville TS to Vaughan MTS on September 1, 1987. In situ measurements of the soil thermal resistivity were performed at 4 locations. At each of these locations, 3 undisturbed soil samples were recovered for laboratory analysis and stage drying thermal resistivity tests.

TEST RESULTS AND DISCUSSION

In situ thermal resistivity tests were performed by using a 20 mm diameter and 1.5 m long thermal probe which was installed into the ground by a power auger machine. The soil samples were collected from depths of 0.45 m, 0.75 m and 1.05 m below the ground surface.

The results of in situ thermal resistivity tests and the soil description from the soil samples are summarized in Table I. The soil types encountered were primarily clayey silt and silty clay. There was no free water in any of the boreholes put down to a depth of 1.5 m. The right-of-way was cultivated and at the time of testing, the field was covered with pepper plants.

In situ thermal resistivity values ranged from 60 to 90 °C cm/W. The results of the stage drying thermal resistivity tests are summarized in Figure 1. It shows that the critical soil moisture level at which a dramatic change in the thermal resistivity occurs, is 6 to 8 per cent by dry weight.

Using a 50 year weather data base, a statistical analysis of the variability of soil moisture and thermal resistivity was performed for the soil type encountered along this route. Results of this prediction are as follows:

Soil Type	Anticipated Maximum Thermal Resistivity °C cm/W for Return Period of 30 years	50 years
Clayey silt	109	120
Silty clay	90	105

CONCLUSIONS

The soil type encountered along the proposed stretch of underground cable route is predominantly clayey silt to silt clay with some fine sand. There was no ground water present within the depth of 1.5 m. A thermal resistivity value of 120 °C cm/W is recommended to be used for the resident soil in the design of cable backfill and the cable ampacity. The crushed limestone screenings that meets Ontario Hydro specifications should be used for cable thermal backfill.

Approved by:

T.W. Klym
Manager
Civil Research Department

Prepared by:

H.S. Radhakrishna
Senior Engineer
Soil Sciences Section

Reviewed by:

T.J. Carmichael
Supervising Engineer
Soil Sciences Section

HSR:LM

TABLE I

SUMMARY OF IN SITU THERMAL RESISTIVITY TESTS

Borehole Sample	Depth (m)	Soil Description	In Situ Thermal Resistivity °C cm/W Test Depth (m)	T/R
BH-1				
S-1	0.45 - 0.60	Brown clayey silt with some organics and coarse sand	0.40	83
S-2	0.75 - 0.90	Brown silty clay with some fine sand	0.80	69
S-3	1.05 - 1.20	Brown clayey silt with some fine to coarse sand	1.20	75
BH-2				
S-1	0.45 - 0.60	Brown clayey silt with some fine sand	0.40	84
S-2	0.75 - 0.90	Brown grey clayey silt	0.80	89
S-3	1.05 - 1.20	Grey clayey silt with some fine to coarse sand	1.20	62
BH-3				
S-1	0.45 - 0.60	Brown silty clay with a trace of organics	0.45	88
S-2	0.75 - 0.90	Brown silty clay	0.80	83
S-3	1.05 - 1.20	Brown clayey silt	1.20	60
BH-4				
S-1	0.75 - 0.90	Fine brown sandy silt	0.80	66
S-2	1.05 - 1.20	Fine brown sandy silt	1.20	58

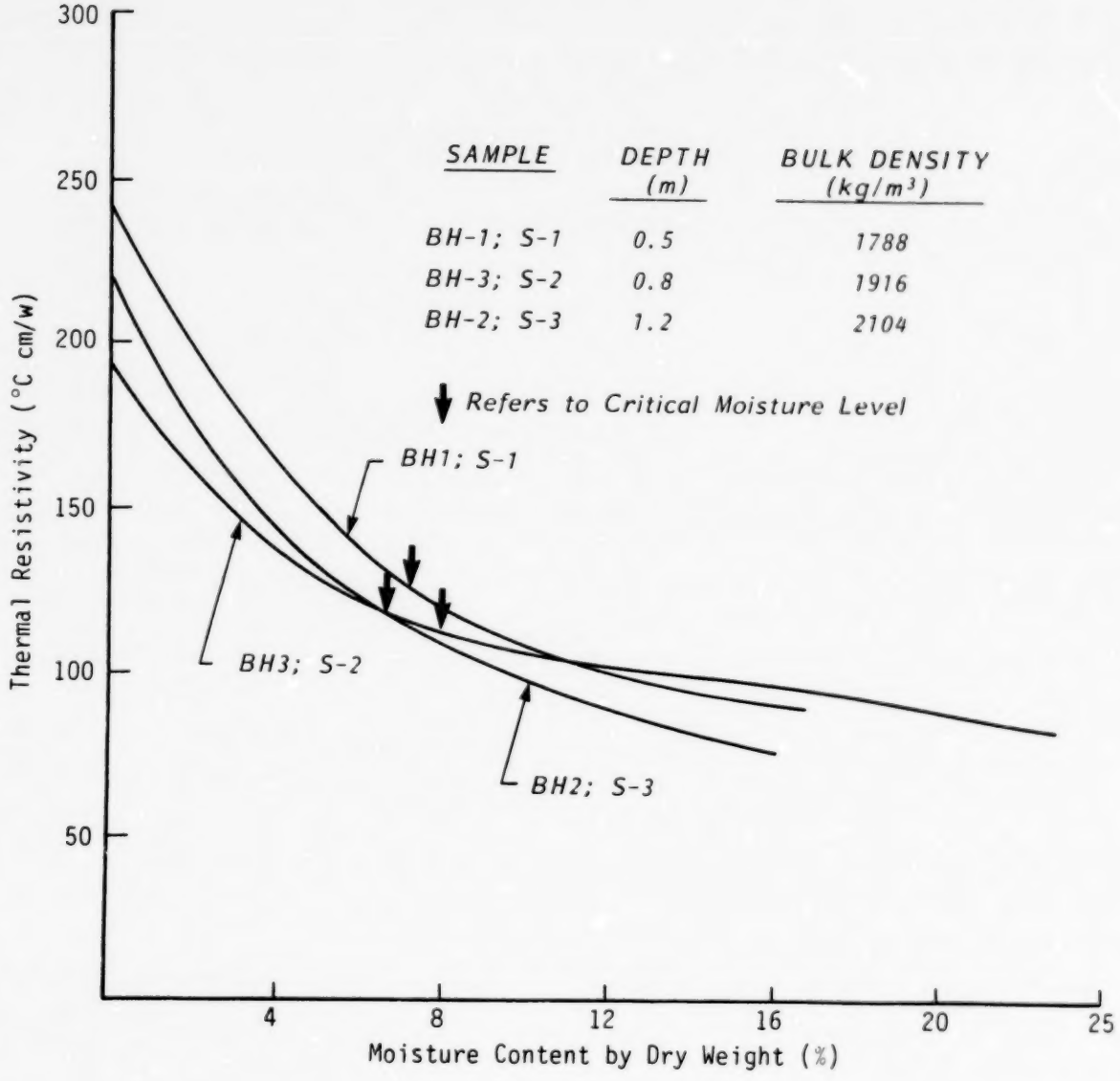

FIGURE 1

THERMAL CONDUCTIVITY VS MOISTURE CONTENT
FROM STAGE DRY TESTS

CLAIRVILLE TO VAUGHAN U/G CABLE ROUTE

DISTRIBUTION

Dr. C.F. Lee — Design and Development Div, H18A20
Mr. R. Jarrett (12) — Design and Development Div, H18D23
Dr. T.W. Klym/Mr. T.J. Carmichael — Civil Research
Dr. H.S. Radhakrishna (2) — Civil Research

Section File (1) KR252
Public Reference Centre
Editorial Section (2)
Office Copies (3)
Extra Copies (3)